

Arkansas Wheat Promotion Board 2004 Annual Report

TITLE: Germplasm Enhancement for Disease Resistance

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OBJECTIVES

To incorporate new genes for disease resistance into soft red winter wheat

To characterize varieties and breeding lines for resistance to important diseases

INTRODUCTION

Diseases are a major limitation to profitable wheat production in Arkansas. Resistant varieties have been the most cost effective means of managing several of these diseases to avoid yield and test weight losses. Many current varieties of soft red winter wheat lack effective resistance to contemporary races of leaf rust, stripe rust, and Septoria leaf blotch. None of the varieties have high levels of resistance to scab or barley yellow dwarf. New races of pathogens tend to develop on previously resistant varieties, necessitating continuous efforts to develop new varieties or use more durable types of resistance. Tan spot is a relatively new disease in Arkansas and seems to develop to epidemic levels wherever wheat is grown using reduced tillage for three or more consecutive years. As more growers switch to reduced tillage to lower production costs, tan spot likely will become a more important disease. This project provides the most comprehensive disease evaluations for varieties and breeding lines of soft red winter wheat and will benefit growers in the short to intermediate term by providing reliable disease ratings for varieties and breeding lines. In the long term, growers will benefit from new varieties with disease resistance that would not have been possible without this project.

Because only one Wheat Board project on diseases was allowed, this project and report contain research that is not directly related to germplasm enhancement. Research in this category includes research on stripe rust by two graduate students and evaluation of fungicides for efficacy against tan spot.

MATERIALS AND METHODS

Disease evaluations. To evaluate varieties and breeding lines for resistance to important diseases, seed of entries from the Arkansas Variety Test, Uniform Eastern and Southern Soft Red Winter Wheat Nurseries (most advanced lines from all soft red winter wheat breeding programs), Gulf-Atlantic Breeders Nursery (advanced lines from southern breeding programs), and the Arkansas Elite and Advanced Nurseries from Dr. Bacon were obtained from the appropriate sources. Approximately 1-2 ounces of seed of each entry were treated with Gaucho insecticide (4 fl oz / cwt) to suppress aphids and barley yellow dwarf and Dividend fungicide (1 fl oz / cwt) to control loose smut and Stagonospora blotch. Except for the Arkansas Observation Nursery which was planted only at Fayetteville, entries

of all nurseries were assembled into one Disease Evaluation Nursery with three replications of each entry plus resistant and susceptible checks for each disease to be evaluated. Individual plots were one row approximately 4 feet long. Disease Evaluation Nurseries were planted at Fayetteville for stripe rust, Kibler for leaf rust and leaf blotch, Pine Tree for tan spot, Clay County for spindle streak mosaic, and Keiser and Jackson County for soilborne mosaic plus spindle streak mosaic.

The Disease Evaluation Nurseries were sprayed 4 to 6 weeks after planting with Warrior insecticide (4 fl oz / A) for aphids and barley yellow dwarf. Nurseries were sprayed for weeds and fertilized as needed. Nurseries for evaluating resistance to soilborne mosaic and spindle streak mosaic were planted in fields with a history of these soilborne diseases. Nurseries for evaluating resistance to tan spot and stripe rust were inoculated and irrigated to promote high disease pressure. The nursery for leaf blotch and leaf rust was irrigated but not inoculated. Data were recorded at an appropriate time for each disease. Results were provided to the Arkansas Cooperative Extension Service, breeders, and seed companies.

Germplasm enhancement. The process of incorporating new genes for disease resistance into soft red winter wheat adapted to Arkansas involves several steps. Sources of resistance are identified, seed of these sources are obtained (often from outside of the United States), sources are crossed to an adapted variety and then usually backcrossed to the adapted variety to improve the probability of recovering adapted lines. Populations from crosses and backcrosses are advanced in bulk and selected for agronomic traits for several generations, and then selected for resistance to particular diseases in later generations. Resistant lines are evaluated for yield and resistance to other diseases, and the best lines are provided to breeders. Currently, crosses are being made and lines are being evaluated for resistance to leaf rust, stripe rust, leaf blotch, and barley yellow dwarf.

Sixty-nine varieties are being evaluated to determine the types of stripe rust resistance and genes for stripe rust resistance in contemporary soft red winter wheat lines. These lines have been evaluated in growth chambers for seedling (all-stage) resistance against four races of stripe rust and in the field during 2003 and 2004 for adult-plant resistance.

Aggressiveness of stripe rust races. To determine if new races are more aggressive than old races, six old and 14 new races were evaluated for latent period (time from inoculation until sporulation) on seedlings of five wheat varieties and for spore germination rate on agar media. Both variables were evaluated at both 54°F (favorable temperature) and 64°F (near upper limit for stripe rust). Races that germinated faster, sporulated sooner, or were able to germinate or sporulate better at the higher temperature were considered more aggressive.

Genetic diversity of the stripe rust fungus. Determining the genetic diversity within the population of the fungus causing stripe rust will help understand why stripe rust has been more severe since 2000 and how spores migrate within North America and between continents. Two molecular techniques, Amplified Fragment Length Polymorphism (AFLP) and Simple Sequence Repeat (SSR), have been shown to differentiate isolates of the fungus in Denmark and France, respectively. Both techniques were used to characterize old (before 2000) and new (2000 and later) isolates of the stripe rust fungus collected in the United States. In addition to support from the Arkansas Wheat Promotion Board, this research was supported by Research Incentive Grants from the Arkansas Agricultural Experiment Station. Data from this research are essential for obtaining federal funding for

stripe rust research.

Evaluation of fungicides for efficacy on tan spot. All registered and two experimental fungicides were evaluated for efficacy against tan spot on the susceptible variety, Pioneer 2580, in the tan spot nursery at the Pine Tree Experiment Station. A growth regulator (Apogee) was included in one of the treatments to determine its effect on plant height, lodging, and yield. Treatments were applied using a CO₂ backpack sprayer at flowering stage on 16 April. Plots were rated for the percentage of foliage affected by tan spot on 27 April and 10 May and harvested on 4 June. Most of this work was done by Rick Cartwright.

RESULTS AND DISCUSSION

Disease evaluations. Reliable data were obtained for spindle streak mosaic, soilborne mosaic + spindle streak mosaic, stripe rust, and leaf diseases (combination of leaf blotch, stripe rust and leaf rust in this order). Insufficient symptoms developed in the tan spot nursery at Pine Tree, and no data were recorded for tan spot. For entries in the Arkansas Variety Test, disease data were converted to disease reactions and combined with powdery mildew data obtained from the Variety Test plot at Lewisville (Table 1). These disease reactions were disseminated as part of a yearly Wheat Update published by the Extension Service to assist growers with selection of resistant varieties. These disease reactions also are utilized by the Delta Agricultural Digest and other states. Actual disease data for entries in individual nurseries that were part of the Disease Evaluation Nursery are listed in Tables 2 through 7 and were disseminated to breeders and seed companies to assist with release of resistant varieties.

Germplasm enhancement. Fifteen F₈, backcross F₇, or topcross F₇ lines with resistance to leaf rust and stripe rust were made available to breeders, and some of these lines are being considered for germplasm releases. Twelve populations from additional sources of leaf rust and stripe rust resistance are in various stages of selection.

Lines and varieties were evaluated for yield and resistance to barley yellow dwarf (BYD) compared to the susceptible check, Pocahontas, in a replicated test under high BYD pressure at Fayetteville (Table 8). Of 12 BCF₆ lines developed from CIMMYT spring wheat sources of resistance to, two lines (99-2022-3-2 and 99-2022-3-3) with the parentage Pioneer 2684*2//Milan/Sha7 had high levels of resistance and good yield potential. Two other lines (99-2029-20-1-3 and 99-2029-20-2-2) with the parentage Mason2*//THB/CEP7780 had moderate resistance and yield potential. Of two lines from Purdue University (P961341A3-1-2 and P961341A3-2-2) with a single major gene from wheatgrass, P961341A3-1-2 had a high level of resistance and good yield potential and may soon be available to growers. Coker 9663 and Roane also had a high level of resistance to BYD. Crosses have been made among all of these resistant lines except those from Purdue to combine minor genes for BYD resistance and develop lines with higher levels of resistance.

Of several hundred potential sources of resistance evaluated in 2003, 30 were chosen for further evaluation in 2004, and eight of these were selected for crossing to three adapted varieties (Agripro Panola, Terral LA 841, and Pat) during the 2004-05 greenhouse season. These selected sources of resistance have reasonably good adaptation to Arkansas and resistance to contemporary races of leaf rust, stripe rust, and leaf blotch and at least moderate resistance to spindle streak and soilborne mosaic. Of several hundred potential

sources of resistance evaluated in 2004, 17 were selected for further evaluation in 2005 before being used as parents in crosses.

Of the 69 contemporary soft red winter wheat lines being evaluated for types of stripe rust resistance and genes for stripe rust resistance, nearly all of the lines are susceptible to one or more of the four races used in the seedling tests, indicating that race-specific seedling (all-stage) resistance is not effective. However, most of the lines express some level of adult-plant resistance in the field, that is, seedlings are susceptible but plants become resistant as they mature. Results to date indicate that adult-plant resistance is common in soft red winter wheat and that most of this resistance is effective only against certain races of the stripe rust fungus. Furthermore, results from 2004 (Table 9) clearly show that these lines differ for resistance to stripe rust infection on heads and that resistance to head infection is independent of resistance to leaf infection. A subset of these lines will be evaluated as adult plants in growth chambers to learn more about the resistance to leaf and head infection.

Aggressiveness of stripe rust races. “New” isolates of the stripe rust fungus that were collected in 2000 and later had shorter latent periods (produced spores sooner after inoculation) on wheat seedlings at 64°F than at 54°F whereas “old” isolates that were collected before 2000 had similar latent periods at both temperatures, except for one isolate that had a shorter latent period at 54°F (Table 10). A similar trend was recorded for spore germination rates (Table 11), but the differences between old and new isolates was not as distinct. These data suggest that new isolates of the stripe rust fungus are better adapted to cause disease at warmer temperatures, and this may have contributed to the increased stripe rust severities observed in 2000 and later throughout south central United States and elsewhere. The graduate student (Esra Seyran) who conducted this research completed the requirements for her Master’s degree in August. Because stripe rust is a problem on adult plants rather than seedlings, further research will be done on flag leaves of adult plants to better evaluate aggressiveness.

Genetic diversity of the stripe rust fungus. Based on results of AFLP analysis (Figure 1), “new” isolates that were collected in 2000 and later were very similar to each other, and “old” isolates that were collected before 2000 were similar to each other. However, new and old isolates formed two distinct groups, indicating that there was a substantial change in the stripe rust population in 2000 and that the new isolates completely replaced the old isolates in the contemporary population. Results for SSR analysis were very similar (data not shown). These results support the differences in aggressiveness (above) that were recorded for old and new isolates. AFLP and SSR analysis appear useful for determining how stripe rust migrates to Arkansas each year as well explaining worldwide migration patterns. A graduate student (Sam Markell) is conducting this research as part of his Ph. D. program.

Evaluation of fungicides for efficacy on tan spot. All fungicides reduced tan spot severity compared to the untreated check (Table 12), but numerical differences were small and there were few significant differences for yield or test weight among treatments because disease pressure was low. Apogee growth regulator reduced plant height but had no effect on lodging because there was little lodging in plots without Apogee. All of the registered fungicides appeared to have similar efficacy against tan spot.

Table 1. Disease reactions for entries in the Arkansas Wheat Variety Test, 2004.

Entry	Spindle streak	Soil borne	Stripe rust	Leaf rust	Powdery mildew	Leaf blotch
AGRIPRO BERETTA	R	R	MR	R	R	MS
AGRIPRO COOPER	R	R	VS	R	MR	
AGRIPRO NATCHEZ	R	R	MR	R	R	MR
AGRIPRO PANOLA	VS	R	R	MS	MR	MS
AGRIPRO SAVAGE	R	R	MS	MR	R	MR
AGS 2000	S	S	S	R	R	MR
AGS 2485	S	VS	VS	R	R	
AR839-25-8-2	R	R	R	MS	R	MR
AR910-9-1	S	R	R	R	R	MS
AR93027-5-1	S	R	S	MR	MR	
AR93035-4-1	R	R	MR	MR	R	MR
ARMOR 2010	MR	R	R	R	S	S
ARMOR 3035	MR	R	MR	MS*	S	MS
ARMOR 3330	R	R	R	MR	MS	MS
AXR 2985	R	R	R	MR	MS	MS
AXR 5109	MR	R	R	MR	MR	MS
AXR 5110	R	R	R	MR	R	MS
CROPLAN GENET 514W	S	MR	VS	R	R	
CROPLAN GENET 554W	R	R	S	R	R	
DELTA GROW 4200	MS	MR	R	R	S	MS
DELTA GROW 4500	MR	R	R	MR	S	MS
DELTA GROW 4888	MR	R	R	MR*	MS	MS
DELTA KING 1551	S	MS	MR	MR	R	S
DELTA KING 7777	MR	R	MR	MS	R	MR
DELTA KING 7900	S	R	R	MR	MS	MR
DELTA KING 9216	S	MR	MS	R*	R	S
DELTA KING 9410	MR	R	R	MR	MS	MR
DELTA KING XTJ 239	R	R	R	MR	R	MS
DELTA KING XTJ 241	S	R	MR	.	.	MS
DELTA KING XTJ 247	R	R	R	.	.	MS
DELTA KING XTJ 251	MR	MR	S	MR	R	
DELTA KING XTJ 253	S	R	MR	MR	R	S
DELTA KING XTJ 261	R	R	S	R	R	
DELTA KING XTJ 271	S	R	R	MR	R	MS
DIXIE 900	S	MR	R	MR*	S	MR
DIXIE 922	MR	R	R	MR*	S	MS
DIXIE 9512	MS	R	MR	R	MS	MR
DIXIE 9812	MS	R	MR	R*	S	MR
DIXIE X949	.	.	R	MR	R	MR
DIXIE X959	S	R	R	R	S	MR

Table 1. Continued.

Entry	Spindle streak	Soil borne	Stripe rust	Leaf rust	Powdery mildew	Leaf blotch
EK EXP 150	.	.	R	MR	MS	MS
EK EXP 160	S	MR	R	R	MS	MS
FFR 521	S	R	S	MR	R	
FFR 522	S	VS	VS	R	R	
FFR 556	R	R	S	MR	R	
FFR 8302	R	R	R	.	.	MR
FFR 8309	.	.	S	.	.	
GENESIS M86	R	R	R	MR	S	MS
GENESIS R023	S	MR	R	R*	S	MS
GENESIS R033	S	R	R	MR*	S	MS
GENESIS R043	S	R	R	MR*	S	MS
GENESIS RO47	R	MR	MR	R	R	MR
GENESIS RO63	MR	R	R	R	S	MS
HBK 3030	R	R	MS	MR	R	S
HBK 3106	S	MR	VS	R	R	
HBK 3266	S	MS	S	R	MR	
LA925C104-1-3-B-4	S	MS	S	R	R	
LA925C104-2	S	MS	S	MR	MR	
LA9560CA22-1	MS	MS	MS	R	R	MR
LA97113UC-124-B	R	R	MR	R	R	MR
LIGHTHOUSE	S	MR	S	MR	R	
McCORMICK	R	R	R	R	R	MS
MD 11-52	R	R	S	S	R	
NK B970051	S	R	S	R	R	
NK COKER 9152	R	R	MS	R	R	MS
NK COKER 9375	S	S	MR	R	R	MS
NK COKER 9663	S	S	S	R*	MR	MR
PAT	R	R	R	MR*	MR	MR
PIONEER 2552	R	R	MR	MR*	R	MR
PIONEER 26R12	S	MR	S	MR	R	
PIONEER 26R15	R	R	MS	MR	MR	S
PIONEER 26R24	S	MS	VS	MR	R	S
PIONEER 26R58	R	R	S	.	MR	
PROGENY 110	VS	R	R	R	MS	MR
PROGENY 133	MS	R	R	MR	MR	MS
PROGENY 145	S	R	R	R*	S	MS
PROGENY 156	MS	MR	R	R	R	MS
PROGENY 166	S	R	R	MR	S	MS
RENWOOD 3706	MR	R	R	R	R	MS
ROANE	S	R	MS	R	R	S

Table 1. Continued.

Entry	Spindle	Soil borne	Stripe rust	Leaf	Powdery	Leaf blotch
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	streak			rust	mildew	
SABBE	S	MS	MR	MS*	R	MR
SOUTH. STATES SS520	R	MR	VS	MR	R	
SOUTH. STATES SS535	S	MS	VS	R	R	MS
SOUTH. STATES SS560	R	R	VS	R*	MR	
TERRAL LA841	S	VS	R	R	R	MS
TERRAL TV8450	MS	MR	MR	R*	S	S
TERRAL TV8466	MR	R	R	MR	MR	MS
TERRAL TV8502	S	MR	R	MR	S	MS
TERRAL TV8565	MR	R	MR	MR	MS	MS
TERRAL TVX81H04	MR	R	R	MS	S	MS
TERRAL TVX82H01	R	R	R	R*	S	S
TERRAL TVX82P201	R	MS	S	MR	MR	
UGA 931233-E17	S	MR	R	R	R	MS
USG 3209	S	MR	MS	MR	MS	MS
USG 3350	MS	R	R	MR	S	MS
USG 3430	MS	R	R	MR*	S	MS
USG 3592	S	MR	S	R	R	
USG EXP 370	R	R	R	R	R	MS
VA97W-024	R	R	S	MS	MR	
VIGORO TRIBUTE	R	MR	S	R	R	MS

* = A race is known to overcome the resistance in this variety, but it was not prevalent in Arkansas during 2004.

Table 2. Disease ratings for entries in the Arkansas Wheat Variety Test, 2004.

Entry	Spindle	Soil borne + Spindle streak		% Stripe	% Leaf area
	streak			rust	diseased
	Clay Co. ¹	Keiser ²	Jackson Co. ³	Fayetteville	Kibler ⁴
AGRIPRO BERETTA	1.0	0.0	0.0	17	43
AGRIPRO D99*5725	5.0	1.0	1.3	3	57
AGRIPRO L96*9266-1	4.0	3.7	1.7	68	76
AGRIPRO M98-2023	0.5	0.0	0.0	83	92
AGRIPRO NATCHEZ	0.5	0.3	0.3	4	30
AGRIPRO SAVAGE	0.5	0.3	0.0	38	37
AGS 2000	5.0	6.3	5.0	57	85
AGS 2485	4.5	8.3	4.3	83	89
AR839-25-8-2	0.0	0.3	0.0	1	27
AR910-9-1	4.0	1.0	0.3	3	32
AR93027-5-1	3.5	0.3	0.3	32	38
AR93035-4-1	1.0	0.0	0.3	10	22
ARMOR 3035	1.0	0.0	0.7	5	50
AXR 2985	0.5	0.0	0.0	2	37
AXR 5109	2.0	0.7	1.0	1	50
AXR 5110	0.0	0.0	0.0	1	43
AXR 5111	2.0	0.0	0.7	1	57
AXR 5888	0.0	0.0	0.0	1	43
CROPLAN GENET 514W	3.5	1.3	0.3	92	93
CROPLAN GENET 554W	1.0	0.0	0.3	37	64
DELTA GROW 4200	2.0	0.0	2.0	0	50
DELTA GROW 4500	2.0	0.3	0.7	1	43
DELTA GROW 4888	1.5	0.0	0.7	1	37
DELTA KING 1551	5.0	2.3	1.3	5	30
DELTA KING 7777	2.0	0.3	0.0	10	30
DELTA KING 7900	4.5	0.3	0.3	1	30
DELTA KING 9216	5.0	0.7	0.7	16	43
DELTA KING 9410	1.0	0.7	0.3	1	30
DELTA KING XTJ 239	0.0	0.0	0.0	1	37
DELTA KING XTJ 241	3.0	0.0	0.7	5	50
DELTA KING XTJ 247	0.5	0.7	0.3	0	37
DELTA KING XTJ 251	1.5	1.7	0.3	63	83
DELTA KING XTJ 253	3.0	0.3	0.0	10	57
DELTA KING XTJ 261	1.0	0.0	0.3	38	32
DELTA KING XTJ 271	4.5	0.7	1.3	1	37
DIXIE 900	3.5	0.7	0.7	1	30
DIXIE 922	0.5	0.0	0.7	1	30
DIXIE 9512	2.5	0.3	1.3	12	30
DIXIE 9812	2.5	0.0	0.3	5	30

Table 2. Continued.

Entry	Spindle streak	Soil borne + Spindle streak		% Stripe rust	% Leaf area diseased
	Clay Co. ¹	Keiser ²	Jackson Co. ³	Fayetteville	Kibler ⁴
DIXIE X949	. ⁵	.	.	3	30
DIXIE X959	3.0	0.0	1.3	1	30
EK EXP 160	5.0	1.3	1.3	1	37
EK EXP 150	. ⁵	.	.	2	37
FFR 521	4.0	1.0	1.3	70	75
FFR 522	4.0	8.3	5.7	75	73
FFR 556	0.0	0.3	0.0	50	80
FFR 8302	0.0	0.0	0.0	2	25
FFR 8309	. ⁵	.	.	63	73
GA 931241E16	3.5	2.3	2.0	32	75
GENESIS M86	0.0	0.3	0.3	0	37
GENESIS R023	4.5	0.7	2.0	2	37
GENESIS R033	4.0	0.7	1.7	1	37
GENESIS R043	4.0	0.0	1.0	1	37
GENESIS R047	0.5	2.3	1.3	4	25
GENESIS RO63	1.5	0.0	0.0	2	43
HBK 3030	0.0	0.0	0.0	24	76
HBK 3106	5.0	2.3	3.0	73	73
LA925C104-1-3-B-4	3.5	2.0	4.3	38	69
LA925C104-2	3.0	3.7	5.0	32	80
LA9560CA22-1	2.5	5.0	5.0	25	38
LA97113UC-124-B	0.5	0.3	0.0	13	20
LIGHTHOUSE	3.5	0.0	2.3	57	45
McCORMICK	0.0	0.0	0.0	3	43
MD 11-52	0.0	0.0	0.0	70	60
NK B970051	4.5	1.0	2.0	32	37
NK COKER 9152	0.5	0.0	0.3	17	43
NK COKER 9375	4.5	8.3	5.0	11	37
NK COKER 9663	3.5	4.3	2.3	50	68
PAT	0.5	0.0	0.0	1	30
PIONEER 2552	0.0	0.7	0.0	5	20
PIONEER 26R12	5.0	1.7	1.3	70	78
PIONEER 26R15	1.0	1.0	0.7	20	57
PIONEER 26R24	5.0	3.7	4.3	83	79
PIONEER 26R58	0.0	0.0	0.0	37	78
PROGENY 110	5.0	1.0	0.3	0	30
PROGENY 133	2.5	0.3	0.3	1	50
PROGENY 145	3.5	1.0	1.0	1	50
PROGENY 156	2.5	0.3	2.3	3	50

Table 2. Continued.

Spindle Soil borne + Spindle streak % Stripe % Leaf area

Entry	streak			rust	diseased
	Clay Co. ¹	Keiser ²	Jackson Co. ³	Fayetteville	Kibler ⁴
PROGENY 166	4.0	0.0	1.7	1	37
RENWOOD 3706	1.5	0.7	0.0	1	43
ROANE	3.5	0.7	2.0	25	50
SABBE	3.5	3.7	3.7	5	30
SOUTH. STATES SS535	3.0	7.7	2.0	80	88
SOUTH. STATES SS520	1.0	2.3	1.0	96	93
SOUTH. STATES SS560	1.0	0.0	0.0	64	95
TERRAL LA841	4.0	9.0	9.0	0	43
TERRAL TV8450	2.5	0.7	1.7	6	57
TERRAL TV8466	2.0	0.7	0.7	3	50
TERRAL TV8502	4.0	1.7	3.0	1	37
TERRAL TV8565	1.0	0.3	0.3	4	50
TERRAL TVX81H04	1.5	0.3	1.7	3	43
TERRAL TVX82H01	0.0	0.3	1.0	3	55
TERRAL TVX82P201	0.0	5.7	5.0	49	85
UGA 931233-E17	4.0	1.3	1.7	1	43
USG 3209	3.0	0.0	0.3	22	43
USG 3350	2.5	0.3	0.3	3	43
USG 3430	2.5	0.3	1.0	1	43
USG EXP 370	0.5	0.0	0.0	1	37
VA97W-024	0.0	0.7	0.0	50	62
VIGORO TRIBUT	0.0	2.0	1.3	50	68
LSD (0.05)	1.9	2.3	2.0	33	30

¹ 0-9 Scale, 0=No symptoms. Rated on March 22. Values of 3 or higher were susceptible.

² 0-9 Scale, 0=No symptoms. Rated on March 23. Values of 6 or higher were susceptible.

³ 0-9 Scale, 0=No symptoms. Rated on March 23. Values of 4 or higher were susceptible.

⁴ At soft dough stage on 7 May. Diseases in order of prevalence were septoria leaf blotch, stripe rust, and leaf rust.

⁵ '.' = missing data because seed did not arrive in time.

Table 3. Disease ratings for entries in the Uniform Southern Soft Red Winter Wheat Nursery, 2004.

Entry	Spindle	Soil borne + Spindle streak		% Stripe rust	% Leaf area
	streak				diseased
	Clay Co. ¹	Keiser ²	Jackson Co. ³	Fayetteville	Kibler ⁴
AGS 2000	5.0	5.7	1.7	50	78
AR910-9-1	3.0	0.0	0.0	0	32
AR93035-4-1	0.0	0.0	1.0	8	43
AW D00-6383	3.7	2.0	0.0	68	75
AW D00*6847	2.7	0.7	0.3	22	58
AW D00*6874	4.3	0.7	0.3	5	45
B980006	1.7	0.3	0.0	0	30
B980416	0.7	0.0	0.7	38	55
B980582	0.0	0.3	0.0	31	57
B980696	1.0	0.7	1.7	1	30
F/G 95195	4.0	2.0	2.0	2	57
F/G 951216-2E14	4.3	3.0	1.7	0	55
F/G 951216-2E26	4.3	3.7	3.7	0	43
G/F 951079-2E31	3.7	3.0	0.0	5	57
G/F 951208-2E35	2.0	0.7	0.0	0	57
G/F 95652-2E56	4.3	3.0	0.7	2	63
G39015	3.0	0.0	0.0	1	43
G39033	1.3	0.0	0.0	1	30
LA925C104-1-3-B-4	2.3	4.0	2.0	32	80
LA9560CA22-1	2.7	6.3	4.3	16	43
LA9585D17-2	3.0	7.0	2.7	73	67
McCormick	0.0	0.0	0.0	6	17
MD11-52	0.0	0.0	0.0	63	84
MD71-5	0.0	0.3	0.3	84	95
MV 5-46	4.0	1.0	1.3	70	88
NC00-15332	2.7	0.3	0.0	6	50
NC00-15385	3.3	0.3	0.3	57	73
NC00-15389	3.3	0.0	0.3	63	84
NC99-13022	0.3	0.0	0.0	16	32
P92226E2-5-3-2	4.0	1.3	0.0	1	10
P961341A3-2-2	0.3	0.5	0.0	57	37
Pioneer 26R61	0.0	0.0	0.0	1	20
SC980890	4.0	1.3	1.0	50	83
SC996284	4.7	5.0	2.7	3	25
SC996289	4.3	7.0	2.0	1	30
TN04-01	0.7	0.7	0.7	63	80
TX00D1626	2.7	2.0	0.0	73	62
USG 3209	1.3	0.0	0.3	17	43
VA00W-526	1.7	0.0	1.0	1	30
VA98W-335	0.3	0.0	0.7	64	85
VA98W-631	0.0	0.0	1.3	11	25
VAN98W-342	0.0	0.0	0.0	78	96
LSD (0.05)	1.9	2.3	2.0	33	30

¹ 0-9 Scale, 0=No Symptoms. Rated on March 22. Values of 3 or higher were susceptible.

² 0-9 Scale, 0=No Symptoms. Rated on March 23. Values of 6 or higher were susceptible.

³ 0-9 Scale, 0=No Symptoms. Rated on March 23. Values of 4 or higher were susceptible.

⁴ At soft dough stage on 7 May. Diseases in order of prevalence were septoria leaf blotch, stripe rust, and leaf rust.

Table 4. Disease ratings for entries in the Uniform Eastern Soft Red Winter Wheat Nursery, 2004.

Entry	Spindle streak	Soil borne + Spindle streak		% Stripe rust	% Leaf area diseased
	Clay Co. ¹	Keiser ²	Jackson Co. ³	Fayetteville	Kibler ⁴
Apple exp.	4.3	1.0	0.7	63	75
AR 910-9-1	3.7	0.0	0.0	3	25
AR 93027-3- 2	3.3	0.0	0.7	38	32
B980006	0.7	0.0	0.3	1	30
B980582	0.7	0.0	0.3	32	37
B980696	0.7	1.0	2.3	1	32
Caldwell	3.0	3.7	1.3	55	50
Danny exp.	0.3	1.3	0.7	10	73
Foster	1.7	0.7	0.3	83	85
G39030	0.3	0.0	0.0	5	30
G39050	1.0	0.3	0.0	2	30
G39186	4.0	2.3	0.7	3	50
GA931233- E17	3.3	2.0	1.3	1	37
IL97-3632	1.0	0.0	0.0	17	25
IL99-15867	1.3	0.3	0.7	62	68
Jolly exp.	0.3	0.3	0.0	5	30
KY93C-0378-5-2	0.0	0.0	0.0	21	25
KY93C-1238-17-1	0.0	0.0	0.3	94	92
M00-3701	4.0	0.3	0.0	1	38
M99-2408	2.3	0.3	0.3	76	84
M99*3098	2.0	0.0	0.0	20	37
MD 11-52	1.7	0.0	0.0	75	75
MO980829	2.7	0.7	0.3	5	25
MO981020	3.3	0.7	0.0	17	43
MSU Line E1007	0.0	0.0	0.0	62	62
MV 5-46	3.3	0.3	2.3	79	85
NY89066-7131	0.0	0.0	0.0	38	79
OH708	1.3	0.0	0.3	57	55
OH743	0.7	2.7	1.0	0	43
OH751	0.3	0.0	0.0	71	85
P91202RB1-3- 3- 4-5	0.0	0.0	0.3	57	68
P961341A3- 1-2	0.7	0.3	0.0	25	20
P97397E1-11-2-4-1-1	0.0	0.0	0.3	63	64
Patton	0.3	0.0	0.7	85	80
Roane	1.3	0.0	0.7	22	43
T141	0.0	0.3	0.3	3	22
T143	3.7	0.3	0.7	37	68
VA00W-526	4.3	0.3	2.3	2	30
VA97W-375WS	0.0	0.0	0.7	70	68
VAN98W-170WS	2.3	0.0	0.3	57	62
WB-1001	0.7	0.0	0.0	2	62
X00-1079	0.3	0.0	0.3	50	63
X00*1118	1.0	2.0	0.0	67	90
LSD (0.05)	1.9	2.3	2.0	33	30

¹ 0-9 Scale, 0=No Symptoms. Rated on March 22. Values of 3 or higher were susceptible.

² 0-9 Scale, 0=No Symptoms. Rated on March 23. Values of 6 or higher were susceptible.

³ 0-9 Scale, 0=No Symptoms. Rated on March 23. Values of 4 or higher were susceptible.

⁴ At soft dough stage on 7 May. Diseases in order of prevalence were septoria leaf blotch, stripe rust, and leaf rust.

Table 5. Disease ratings for entries in the Gulf-Atlantic Soft Red Winter Wheat Nursery, 2004.

Spindle Soil borne + Spindle streak % Stripe % Leaf area

Entry	streak			rust	diseased
	Clay Co. ¹	Keiser ²	Jackson Co. ³	Fayetteville	Kibler ⁴
AGS 2000	3.7	5.7	6.3	43	84
AR94047-5-1	5.0	6.3	5.0	1	20
AR94112-7-1	3.0	6.3	4.3	20	43
AR95047-6-1	4.5	2.0	3.0	68	92
AR95047-8-1	3.0	0.7	1.3	57	84
AR95049-3- 1	4.5	2.3	3.0	62	80
AR95049-4-1	5.0	2.3	2.3	62	92
AR95108-5-2	0.0	0.0	0.3	1	30
AR95108-5-3	0.0	0.0	0.0	29	50
AR95125-1-1	5.0	3.7	3.0	6	68
FL95282-B1-D1	4.3	4.3	2.7	67	75
FL95282-B13- C2-D4	3.0	3.0	1.7	67	85
FL95345-A10-C5	1.7	1.3	0.0	3	98
FL9547-B15-C1-D3	5.0	7.7	4.3	1	55
FL9547-B15-D4	5.0	7.7	5.0	1	48
FL9547-B8-C3	5.0	7.7	3.7	4	80
FL98208-D24	2.0	0.3	0.7	37	70
FL99089-D35	5.0	3.3	3.7	80	80
FL99089-D58	4.7	5.7	3.7	43	68
GA 951395-3E27	0.3	1.3	0.0	13	58
GA 951395-3E25	0.0	0.3	0.0	6	57
GA 961526-3E15	4.0	3.0	2.3	68	72
GA 96229-3E39	4.7	3.0	3.7	1	50
GA 961591-3E42	1.3	0.3	0.0	45	76
GA 951395-3A31	0.3	0.3	0.3	7	57
GA 96229-3A41	4.5	3.7	4.3	0	20
GA 961591-3A46	3.5	0.7	1.0	57	89
GA 961176-3A48	4.5	0.7	1.7	1	68
LA9319D5-1-2-B-3	3.0	0.5	0.0	10	50
LA95125BUB73- 2-2-B	3.0	5.0	0.7	25	71
LA95135D54-2-3- C	4.3	5.0	3.7	4	45
LA95171CA58-3- 1-C	4.3	4.0	3.7	0	48
LA95283CA78-1-2-B	5.0	6.0	2.7	1	30
LA95361CA62-1-2-C	2.7	3.0	0.3	2	37
LA97113UC-124-3- B	0.3	0.3	0.0	0	30
LA9759UC-29-2-B	2.7	1.3	0.0	38	88
LA98207BUB-37-4-B	3.0	2.0	1.0	1	78
McCormick	0.0	0.0	0.3	0	15
NC01-26765	4.7	3.0	1.3	96	95
NC01-27049	0.0	0.5	0.3	68	90
NC01-27303	0.0	0.0	0.0	90	95
NC01-27308	0.7	0.3	0.0	70	80
NC01-27392	2.0	0.3	0.0	89	80

Table 5. Continued.

Spindle streak	<u>Soil borne + Spindle streak</u>	% Stripe rust	% Leaf area diseased
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Entry	Clay Co. ¹	Keiser ²	Jackson Co. ³	Fayetteville	Kibler ⁴
NC01-27524	3.0	0.3	0.0	30	50
NC01-27750	3.0	0.3	0.3	75	50
NC01-27812	4.3	5.7	3.3	15	37
NC01-28087	1.3	0.3	0.0	84	92
SC000521	4.0	5.0	3.3	17	83
SC001454	4.0	7.0	6.3	1	55
SC001699	4.5	8.0	3.7	7	37
SC002048	4.5	2.7	1.7	90	96
SC002051	3.5	2.0	1.0	87	94
SC002054	1.0	0.7	0.0	92	96
SC006424	5.0	7.7	6.3	50	92
SC981395	4.5	8.3	5.7	50	83
SC981730	4.0	4.0	3.0	63	84
USG 3209	3.0	0.3	1.3	25	50
VA01W-310	4.0	1.7	0.0	89	88
VA02W-124	0.5	0.0	1.7	11	55
VA02W-370	3.5	0.3	0.3	1	63
VA02W-398	0.0	0.7	0.3	50	83
VA02W-513	4.5	0.3	0.7	45	63
VA02W-519	3.5	0.3	1.7	87	90
VA02W-553	1.0	0.3	0.3	5	80
VA02W-567	0.5	0.0	0.0	68	68
VA02W-596	4.0	0.0	2.0	7	43
LSD (0.05)	1.9	2.3	2.0	33	30

¹ 0-9 Scale, 0=No Symptoms. Rated on March 22. Values of 3 or higher were susceptible.

² 0-9 Scale, 0=No Symptoms. Rated on March 23. Values of 6 or higher were susceptible.

³ 0-9 Scale, 0=No Symptoms. Rated on March 23. Values of 4 or higher were susceptible.

⁴ At soft dough stage on 7 May. Diseases in order of prevalence were septoria leaf blotch, stripe rust, and leaf rust.

Table 6. Disease ratings for entries in the Arkansas Elite Wheat Nursery, 2004.

Entry	Spindle	Soil borne + Spindle streak		% Stripe rust	% Leaf area
	streak Clay Co. ¹	Keiser ²	Jackson Co. ³	Fayetteville	diseased Kibler ⁴
AR839-25-8-2	0.0	0.3	0.0	1	37
AR910-9-1	4.3	0.7	0.3	3	25
AR93027-5-1	5.0	0.3	0.3	22	32
AR94112-7-1	3.3	5.0	3.0	12	25
AR93005-6-5	1.0	0.7	0.3	1	37
AR94047-5-1	4.0	5.0	5.7	2	17
AR93035-4-1	0.3	0.3	1.0	7	25
AR93035-4-2	0.7	0.3	2.7	12	43
AR93027-3-2	2.3	1.3	0.3	29	32
AR93005-6-1	2.7	0.7	0.3	0	32
AR850-1-1	0.0	0.0	0.3	2	32
AR95047-6-1	3.7	2.3	2.3	62	95
AR95049-4-1	4.0	2.3	2.3	62	96
AR95047-8-1	2.7	1.3	2.0	57	88
AR95125-1-1	4.7	2.3	2.0	7	71
AR95049-3-1	4.0	0.7	2.3	55	83
AR95108-5-3	0.0	0.0	0.3	22	37
AR95108-5-2	0.0	0.0	0.0	0	32
ARGE97-3005-17-1	2.0	1.7	0.7	0	37
ARLA85411	2.0	7.0	6.3	1	37
ARGE97-1017-4-1	2.0	1.0	1.7	0	38
AR96071-32	3.3	1.0	1.3	1	50
ARGE97-0030-3-3	1.0	0.7	0.0	0	30
ARGE97-1058-4-2	2.0	2.0	1.0	5	57
ARGE97-0027-3-3	1.3	0.7	0.0	7	43
AR93005-6-4	1.3	0.7	0.3	2	43
TX01D3160	3.7	1.3	1.7	71	83
TX02D5270	1.7	1.7	1.0	8	30
TX02D5544	3.3	2.3	0.3	46	55
TX02D6443	4.7	3.0	1.0	50	93
TX94-34-3	3.7	0.3	1.7	59	90
TX96-1-5	0.7	0.0	0.7	61	83
TX96-4-3	3.7	2.3	3.0	79	90
TX96-26	4.0	0.7	0.3	83	90
TX96-35-1	0.3	0.3	0.3	78	92
TX96-43-1	0.3	0.3	0.0	64	94
SABBE	3.3	5.0	2.0	4	37
PAT	0.0	0.0	0.0	1	43
DELTA KING 9410	1.0	0.0	0.0	3	43
AGS 2000	4.3	7.0	5.0	32	63
COKER 9663	3.3	5.0	1.3	43	43
DIXIE 900	3.0	0.3	0.3	1	43
LSD (0.05)	1.9	2.3	2.0	33	30

¹ 0-9 Scale, 0=No Symptoms. Rated on March 22. Values of 3 or higher were susceptible.

² 0-9 Scale, 0=No Symptoms. Rated on March 23. Values of 6 or higher were susceptible.

³ 0-9 Scale, 0=No Symptoms. Rated on March 23. Values of 4 or higher were susceptible.

⁴ At soft dough stage on 7 May. Diseases in order of prevalence were septoria leaf blotch, stripe rust, and leaf rust.

Table 7. Disease ratings for entries in the Arkansas Advanced Wheat Nursery, 2004.

Entry	Spindle streak		% Stripe rust	% Leaf area diseased	
	Clay Co. ¹	Soil borne + Spindle streak			
		Keiser ²	Fayetteville	Kibler ⁴	
AGS2000	4.0	7.0	3.7	43.3	77.7
AR96001-2-1	5.0	2.3	1.0	36.7	75.0
AR96001-2-2	4.7	4.3	2.7	56.7	70.0
AR96003- 5-1	4.0	2.3	3.0	75.0	68.3
AR96004-1-1	0.7	1.0	0.3	0.0	43.3
AR96007-4-2	1.0	0.3	0.0	20.0	36.7
AR96008-4-1	5.0	4.3	4.3	9.7	94.7
AR96008-4-3	5.0	4.3	5.7	43.3	93.7
AR96015-1-1	0.7	0.0	0.0	0.7	35.7
AR96015-1-2	0.3	0.0	0.0	0.0	35.7
AR96015-7-1	1.0	0.0	0.3	2.3	50.0
AR96024-4-1	1.7	2.7	2.3	0.0	30.0
AR96024-4-2	4.0	2.0	1.7	0.0	30.0
AR96031-1-1	0.0	0.0	0.0	40.7	70.0
AR96049-2-1	0.0	0.3	0.0	43.3	70.0
AR96052-4-2	3.7	2.3	0.7	28.0	50.0
AR96052-4-3	4.0	2.3	0.3	33.3	56.7
AR96056-5-2	2.7	2.3	0.3	55.0	90.3
AR96062-6-1	3.7	2.3	0.3	38.3	50.0
AR96077-10-1	2.0	0.7	0.3	0.7	43.3
AR96077-2-1	2.7	2.3	1.0	79.3	93.0
AR96077-3- 1	0.3	0.7	0.3	4.7	56.7
AR96077-7-2	1.7	1.0	1.3	20.0	50.0
AR96077-7-3	2.3	1.7	1.3	31.7	56.7
AR96081-6-1	3.0	1.3	2.3	50.0	71.0
AR96081-7-1	3.3	0.7	0.3	20.0	68.3
AR96081-7-2	3.0	0.7	0.3	12.3	68.3
AR96082-3- 2	3.0	5.7	1.7	61.7	85.3
AR96086-2-1	5.0	1.7	0.7	12.3	78.7
AR96131-10-1	5.0	7.0	5.7	75.0	85.3
AR96135-4-1	1.0	5.0	3.7	68.3	77.7
AR96135-7-1	3.0	5.7	3.7	50.0	71.0
AR96135-7-2	1.3	6.3	3.7	50.0	66.7
AR96136-5-1	3.7	4.3	1.7	61.7	78.7
AR96136-8-1	3.7	1.7	1.0	61.7	94.7
AR96138-1-1	5.0	2.3	3.7	70.0	90.3
AR96138-7-1	4.7	2.3	2.3	63.3	87.7
AR96140-8-1	4.3	3.0	3.7	80.0	94.7
AR96141-4-1	4.7	4.3	3.0	36.7	80.0
AR96141-5-1	4.7	4.3	5.0	31.7	82.7
AR96142-2-1	3.7	3.0	2.3	56.7	93.0
AR96143- 1-1	2.7	7.0	3.7	0.7	36.7
AR96143- 8-1	2.7	6.3	5.0	25.0	50.0

Table 7. Continued

Entry	Spindle streak	Soil borne + Spindle streak		% Stripe	% Leaf area
	Clay Co. ¹	Keiser ²	Jackson Co. ³	Fayetteville	Kibler ⁴
AR96146-2-1	0.0	2.3	3.7	68.3	93.0
AR96146-2-2	1.3	1.7	3.7	68.3	85.3
AR96146-2-3	0.0	3.7	1.0	55.0	90.3
AR96146-3- 1	4.7	3.7	1.3	55.0	93.0
AR96150-2-1	5.0	3.7	1.0	56.7	94.7
AR96154-2-1	4.0	0.3	1.0	61.7	94.7
AR96154-5-1	3.7	1.0	0.3	73.3	98.0
AR96158-2-1	1.7	0.0	0.3	61.7	82.7
AR96161-4-1	4.3	0.0	0.0	25.0	56.7
AR96161-4-2	4.0	0.3	0.0	30.0	43.3
AR96161-5-2	4.0	4.3	1.0	1.3	36.7
AR96163- 1-1	1.0	1.0	1.7	0.7	31.7
AR96163- 3- 1	3.3	2.3	2.3	63.3	96.3
AR96163- 4-1	4.0	5.7	5.0	3.0	55.0
COKER9663	3.0	5.7	3.7	56.7	61.7
PAT	0.3	0.0	0.0	3.7	31.7
SABBE	1.7	5.0	2.3	3.7	36.7
LSD (0.05)	1.9	2.3	2.0	33.1	30.1

¹ 0-9 Scale, 0=No Symptoms. Rated on March 22. Values of 3 or higher were susceptible.

² 0-9 Scale, 0=No Symptoms. Rated on March 23. Values of 6 or higher were susceptible.

³ 0-9 Scale, 0=No Symptoms. Rated on March 23. Values of 4 or higher were susceptible.

⁴ At soft dough stage on 7 May. Diseases in order of prevalence were septoria leaf blotch, stripe rust, and leaf rust.

Table 8. Ratings for resistance to barley yellow dwarf and relative yield potential of the most resistant entries compared to the susceptible check, Pocahontas, at Fayetteville.

Entry	BYD Resistance (Milus scale) ¹			Yield ² (bu/A)
	April 19	May 10	May 20	
Pocahontas				87
99-2022-3- 2		★★★	★★★★★	129
99-2022-3- 3		★★★★★	★★★★★	130
99-2029-29-1-3	★	★★★		89
99-2029-29-2-2	★	★★★		94
P961341A3- 1-2	★★★★★	★★★	★★★★★	118
P961341A3- 2-2	★★★	★★	★	99
Coker 9663	★★★★★★	★★★★★★	★★★★★★	152
Roane		★★★★★	★★★★★	148

¹ Each ‘★’ indicates that the entry expressed resistance relative to the susceptible check, Pocahontas, in one of six replications. Six ★’s indicates the entry was resistant in all six replications.

² Yields from small plots likely over-estimated yield that would be measured in larger plots, and are intended to show relative yield potentials among the entries.

Table 9. Stripe rust ratings on leaves and heads of entries selected to determine the types of stripe rust resistance in soft red winter wheat, 2004.

Entry	% Stripe rust on leaves		% Infected florets
	Fayetteville	Kibler	Fayetteville
AGRIPRO HICKORY	96	80	68
AGRIPRO NATCHEZ	1	11	1
AGRIPRO PATTON	93	98	19
AGRIPRO SAVAGE	43	25	5
AGRIPRO SHELBY	57	68	13
AGRIPRO SHILOH	38	63	0
AGS 2000	70	83	13
AR 800-1-3- 1	5	0	1
AR 910-9-1	5	50	4
AR 93027-5-1	75	32	9
AR 93035-4-1	7	5	2
AR 94071-3- 1	3	5	3
AR 94194-2-3	96	72	68
ARMOR 3035	1	27	1
ARMOR 4045	3	13	3
ARMOR 5222	1	43	1
ARMOR 5333	5	13	5
B950943	85	25	15
B960457	15	10	0
B961378	85	84	13
B961416	83	60	9
COKER 9152	10	32	8
COKER 9184	70	70	3
COKER 9663	75	34	6
Coker 9835	93	96	33
DK 1551	5	55	2
DK 7777	1	57	1
DK 7900	1	45	6
DK 9027	25	12	3
DK 9121	75	50	3
DK 9216	25	38	3
DK 9333	32	22	5
DK 9410	2	37	5
FFR 510	96	97	0
FFR 521	75	80	0
FFR 522	80	73	4
FFR 556	63	89	1
LA 90185G3- 1-3- 4-2	85	90	14
LA 92230 D 6-3- 1	12	31	11
LA 9330D11-1	63	76	7
LA 9415 D 104-5-2	0	8	3

Table 9. Continued.

Entry	% Stripe Rust		% Infected florets
	Fayetteville	Kibler	Fayetteville
LA TERRAL 841	0	5	8
McCORMICK	0	89	18
OHIO 669	3	84	1
OHIO 708	38	46	4
OHIO 712	1	21	2
OHIO 738	38	25	2
OHIO 753	96	100	12
OHIO HOPEWELL	22	22	2
PAT	1	8	1
PIONEER 2552	0	20	1
PIONEER 26R12	63	68	1
PIONEER 26R24	85	88	3
PIONEER 26R38	0	12	2
PIONEER 26R46	43	15	5
PIONEER 26R58	38	85	3
PIONEER 2684	95	83	11
ROANE	12	63	0
SABBE	12	7	1
SISSON	95	99	7
TERRAL LA 422	83	83	34
TERRAL LA 841	1	5	1
TRIBUTE	27	83	11
TV TERRAL 8450	1	37	6
TV TERRAL 8466	8	30	1
TV TERRAL 8555	16	31	18
TV TERRAL 8565	1	8	9
USG 3209	17	5	1
VA 98W-631	11	0	2
LSD (0.05)	33	30	11

Table 10. Latent period of *Puccinia striiformis* f. sp. *tritici* isolates averaged across five wheat cultivars at 54 and 64°F and ranked by the difference between latent periods at 54 and 64°F.

Isolate ¹	Latent period (days) ²	
	54°F	64°F
AR00-05-SP1	13.0	9.1*
AR03- 33- SPF	12.4	10.1*
AR03- 25-SPF	12.0	9.7*
01-69	11.1	9.1*
2K-129-SP	11.5	9.7*
AR03- 04-SPF	12.7	11.0*
01-118	10.6	9.1*
AR03- 31-SPF	12.9	11.5*
AR03- 17b-SPF	10.8	9.5*
AR03- 17a-SPF	11.2	10.0*
AR00-02-SP1	11.0	9.9*
AR03- 01-SPF	10.9	9.8*
AR03- 14-SPF	10.1	9.2*
2K-127-SP	11.1	10.2*
CDL-3- 2-SP	10.8	10.0*
AR90-01-SP	11.7	11.4
CDL-8-3- SP	12.3	12.0
CDL-35-3	12.5	12.7
CDL-6-3	12.4	13.1
AR97-01-SP	11.0*	12.0

¹ Isolates in bold were collected before 2000 and considered “old”; others were collected in 2000 or later and considered “new”.

² An asterisk (*) indicates that latent period within a row was significantly shorter ($P \leq 0.05$) than the latent period at the other temperature by a contrast between the two means. Latent periods within a temperature differing by less than 0.8 days were not significantly different according to an LSD test ($P=0.05$).

Table 11. Urediospore germination of *Puccinia striiformis* f. sp. *tritici* isolates at 54 and 64°F expressed as percentage germinated after 12 h (based on analysis of arcsine-transformed data) and as area under the germination curve (AUGC; based on data recorded at 3, 6, and 12 h) and ranked by the difference between AUGC at 54°F and 64°F.

Isolate ¹	AUGC ³		Germination at 12 h (%) ^{2,4}	
	54°F	64°F	54°F	64°F
AR03- 17a-SPF	146	745*	26	96*
2K-127-SP	104	466*	20	69*
AR90-01-SP	276	636*	53	84*
AR03- 17b-SPF	92	427*	17	53*
AR00-02-SP1	48	310*	10	50*
01-118	622	861*	99	99
AR00-05-SP1	56	248*	12	56*
01-69	817	1006*	96	100
2K-129-SP	53	207*	8	41*
CDL-8-3- SP	25	95	3	19*
AR03- 33- SPF	5	54	1	15*
AR97-01-SP	29	63	4	4
AR03- 25-SPF	17	36	3	6
AR03- 31-SPF	6	22	<1	3
AR03- 04-SPF	17	15	<1	<1
CDL-35-3	136	87	22	14
AR03- 01-SPF	88	24	16*	2
AR03- 14-SPF	111	32	15	6
CDL-3- 2-SP	178*	40	24*	7
CDL-6-3	164*	25	29*	7

¹ Isolates in bold were collected before 2000 and considered “old”; others were collected in 2000 or later and considered “new”.

² An asterisk (*) indicates that percentage of spores germinated after 12 h or AUGC within a row was significantly higher (P=0.05) than the value at the other temperature.

³ AUGC values within a temperature differing by less than 83 were not significantly different according to an LSD test (P=0.05).

⁴ Percent germination values within a temperature differing by less than 12 were not significantly different according to a LSD test (P=0.05).

Table 12. Effect of foliar fungicides on tan spot and yield of Pioneer 2580 wheat, 2004.

Treatment	Rate/A	Yield ¹ (bu/A)	Test wt (lb/bu)	Tan spot (%)		Height (in.)	Lodging (%)
				April 27	May 10	June 4	June 4
Headline	6.4 fl oz	84.2 a	58.0 a	7 b	6 b	38 a	4 a
Flutriafol	14 fl oz	81.3 ab	58.0 a	8 b	7 b	38 a	4 a
Propimax	4 fl oz	81.0 ab	58.2 a	7 b	6 b	38 a	6 a
Quilt	12.8 fl oz	81.0 ab	58.2 a	7 b	5 b	38 a	5 a
Headline	9.2 fl oz	80.7 ab	58.6 a	7 b	6 b	38 a	8 a
Headline + Apogee	6.4 fl oz + 8 oz	80.4 ab	58.1 a	7 b	6 b	36 b	4 a
Stratego	8 fl oz	79.9 ab	58.6 a	7 b	6 b	38 a	4 a
Stratego	10 fl oz	78.5 ab	58.2 a	7 b	6 b	38 a	5 a
BAS 555 + Headline	18.77 fl oz + 4 fl oz	76.2 ab	58.6 a	6 b	7 b	38 a	3 a
Tilt	4 fl oz	76.0 ab	58.3 a	7 b	6 b	38 a	4 a
Quilt	10 fl oz	76.0 ab	58.1 a	6 b	7 b	38 a	5 a
BAS 555	18.77 fl oz	73.2 ab	57.7 ab	5 b	7 b	38 a	6 a
Untreated		72.2 b	57.0 b	12 a	23 a	38 a	9 a

¹ Means within a column followed by same letter do not significantly differ (P=0.05, Student-Newman-Keuls).

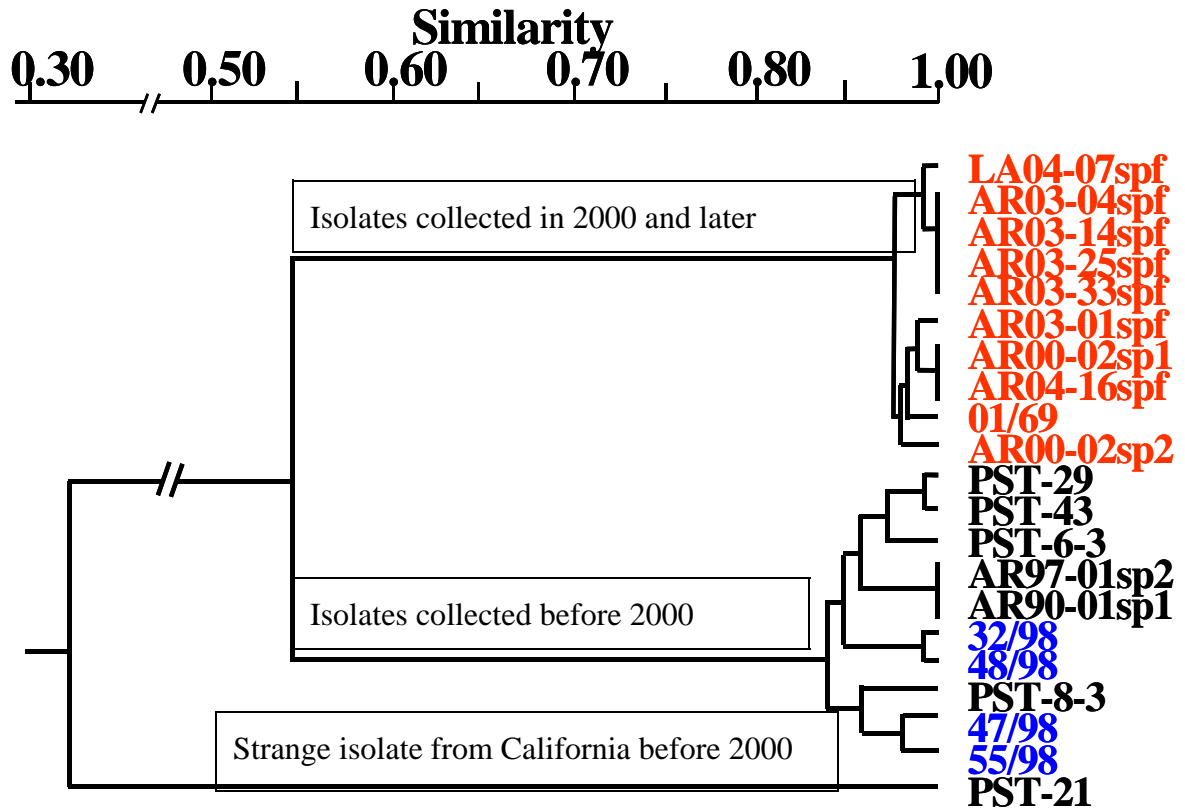


Fig. 1. Relationships among isolates of the stripe rust fungus as determined by AFLP analysis